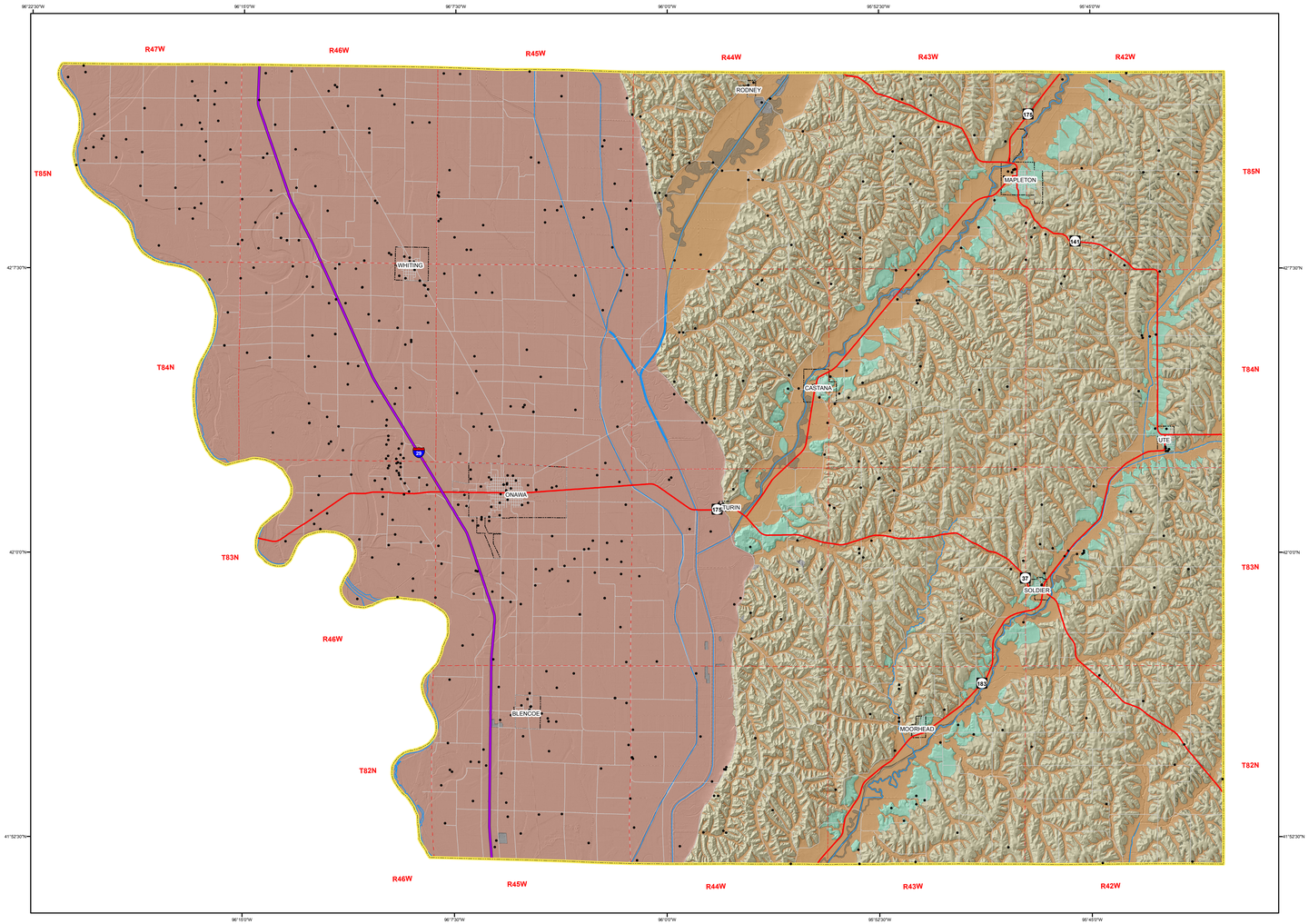
Surficial Geology of Monona County, Iowa



SURFICIAL GEOLOGY OF MONONA COUNTY, IOWA

Iowa Geological and Water Survey
Open File Map OFM-13-10
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prepared by

Stephanie Tassier-Surine[1], James Giglierano[1], Deborah Quade[1], and E. Arthur Bettis, III[2]

Iowa Geological and Water Survey, Iowa City, Iowa

Iowa Department of Natural Resources, Chuck Gipp, Director
Iowa Geological and Water Survey, Robert D. Libra, State Geologist

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[1]Iowa Geological and Water Survey, Iowa City, Iowa 52242
[2]Department of Earth and Environmental Sciences, The University of Iowa, 121 Trowbridge Hall, Iowa City, Iowa 52242

LEGEND

CENOZOIC

QUATERNARY SYSYTEM

HUDSON EPISODE

Qal – Alluvium (DeForest Formation-Undifferentiated) Variable thickness of less than 1 to 5 m (3-16 ft) of very dark gray to brown, noncalcareous to calcareous, stratified silty clay loam, clay loam, loam to sandy loam alluvium and colluvium in stream valleys, on hill slopes and in closed depressions. May overlie Pre-Illinoian glacial till of the Wolf Creek or Alburnett formations or Pre-Holocene fine-grained alluvium. Associated with low-relief modern floodplain, closed depressions, modern drainageways or toeslope positions on the landscape. Unit also includes colluvial deposits derived from adjacent map units. Seasonal high water table and potential for frequent flooding.

Qalfc – Missouri River Valley – Flood Basin/Channel Belt (DeForest Formation- Undifferentiated) Variable thickness of 3 to 10 m (10-33 ft) of very dark gray to brown, calcareous to noncalcareous, massive to stratified silty clay loam to loam to sandy loam alluvium and colluvium in the Missouri River valley. Alluvium overlies a thick 3 to 38 m (10-125 ft) sequence of medium sand to pebbly sand outwash of the Noah Creek Formation. Associated with low-relief modern floodplain. Seasonal high water table and potential for frequent flooding.

Qallt – River Channel Belt – Low Terrace (DeForest Formation-Camp Creek Mbr. and Roberts Creek Mbr.) Variable thickness of less than 1 to 5 m (3-16 ft) of very dark gray to brown, noncalcareous, stratified silty clay loam, loam, or clay loam, associated with the modern channel belt of the Little Sioux, Maple, and Soldier river valleys. Overlies Pre-Holocene fine-grained alluvium. Occupies lowest position on the floodplain i.e. modern and historic channel belts. Oxbow lakes and meander scars are common features associated with this terrace level. Mapped primarily using aerial imagery and county soil survey data. Seasonal high water table and frequent flooding potential.

HUDSON AND WISCONSIN EPISODE

WISCONSIN EPISODE

Qpt- Loess Mantled Terrace (Peoria Formation – silt and/or sand facies) 2 to 9 m (7-30 ft) of yellowish brown to gray, massive, jointed, calcareous or noncalcareous, silt loam and intercalated fine to medium, well sorted, sand. May grade downward to poorly to moderately well sorted, moderately to well stratified, coarse to fine feldspathic quartz sand, loam, or silt loam alluvium (Late Phase High Terrace) or may overlie a Farmdale Geosol developed in Roxanna Silt which in turn overlies a well-expressed Sangamon Geosol developed in poorly to moderately well sorted, moderately to well stratified, coarse to fine sand, loam, or silt loam alluvium (Early Phase High Terrace).

Qps – Loess (Peoria Formation—silt facies) Generally 8 to 46 m (25-150 ft) of yellowish to grayish brown, massive, jointed calcareous or noncalcareous silt loam to silty clay loam. Deposits are thickest in the western portion of the county in the Loess Hills landform region and thin to the east. Limited areas of fine eolian sand may be present near major river valleys. Overlies a grayish brown to olive gray silty clay loam to silty clay (Pisgah Formation—eroded Farmdale Geosol) which is less than 1.5 m (5 ft) thick. The Farmdale may be welded to an older Sangamon Geosol developed in loamy glacial till of the Wolf Creek or Alburnett formations. This mapping unit encompasses upland divides, ridgetops and convex sideslopes. Well to somewhat poorly drained landscape.

PRE-ILLINOIS EPISODE

Qwa3 – Till (Wolf Creek or Alburnett Formations) Generally 15 to 91 m (50-300 ft) of very dense, massive, fractured, loamy glacial till of the Wolf Creek or Alburnett formations with or without a thin loess mantle (Peoria Formation—less than 2 m) and intervening clayey Farmdale/Sangamon Geosol. This mapping unit encompasses narrowly dissected interfluves and side slopes, and side valley slopes. Drainage is variable from well drained to poorly drained.

Other Mapping Units

Qpq – Pits and Quarries Sand and gravel pits and rock quarries. Extent mapped as shown in county soil surveys and as identified on aerial imagery.

Water Features Rivers, lakes and small ponds formed by blockage of drainageways and river channels. Extent mapped as shown in county soil surveys and as identified on aerial imagery.

Water Wells

Correlation of Map Units

Alluvial Deposits	Eolian Deposits	Glacial Deposits			
Qal			Hudson	Holocene	QUATERNARY
Qalfc					
Qallt					
	Qpt		Wisconsin	Pleistocene	
	Qps				
		Qwa3	Pre-Illinois		

Introduction to the Surficial Geology of Monona County, Iowa

Monona County lies within the Southern Iowa Drift Plain and Loess Hills (Prior and Kohrt, 2006) landform regions of Iowa. Surficial materials consist of a mix of eolian deposits (loess), glacial till outcrop, and alluvium. Multiple periods of Quaternary glaciation and subaerial erosion have led to the landscape we see today. Generally speaking, the map area consists of loess of variable thickness overlying Pre-Illinois glacial sediments. These deposits are regionally extensive.

Previous surficial geologic mapping of the area is limited to the Des Moines 4° x 6° Quadrangle at a scale of 1:1,000,000 (Hallberg et al., 1991). Compilation mapping was completed near the project area in 2011 and 2012 for Adams County (Tassier-Surine et al., 2011), Mills County (Tassier-Surine et al., 2012a), and Montgomery County (Tassier-Surine et al., 2012b). Shimek (1909a) first described and mapped the Quaternary geology of Monona County and discussed the stratigraphy of the Pennsylvanian bedrock units. Statewide bedrock geologic maps by Hershey (1969), and most recently, by Witzke, Anderson, and Pope (2010), depict the increased understanding of the distribution of geologic units at the bedrock surface across this region, including Monona County.

Early researchers believed there were only two episodes of Pre-Illinois glaciation in Iowa: Kansan and Nebraskan (Chamberlin, 1894, 1895; Bain, 1896; Shimek, 1909b; Kay and Apfel, 1928; Ruhe, 1969). Later regional studies determined that the original concept of Kansan-Aftonian-Nebraskan was grossly oversimplified and flawed. It is now recognized that there were at least seven episodes of Pre-Illinois glaciation that occurred in this region from approximately 2.2 to 0.5 million years ago (Boellstorff, 1978a, 1978b; Hallberg, 1980a, 1986). Episodic erosion during the last 500,000 years has led to the destruction of preexisting glacial landforms associated with these glaciations. Boellstorff (1978a, 1978b) and Hallberg (1980a, 1980b, 1986) undertook regional-scale projects that involved detailed outcrop and subsurface investigations including extensive laboratory work and synthesis of previous studies. These studies led to the abandonment of the classic glacial and interglacial terminology: Kansan, Aftonian, and Nebraskan. This study marked a shift from the use of time-stratigraphic terms to lithostratigraphic classification. The result of Bollestorf's and Hallberg's studies was the development of a lithostratigraphic framework for Pre-Illinois till. They developed a general stratigraphic framework for Iowa and eastern Nebraska based on physical stratigraphy, mineralogic criteria as well magnetostratigraphy and tephrochronology. In western Iowa and eastern Nebraska three lithologically distinctive till assemblages were identified, the "A", "B", and "C" tills with paleosols sometimes delimiting multiple till units within the A and B till assemblages. Recent work by Balco and Rovey (2010) suggests that a single ice advance around 2.4 Ma deposited the C till and that the A and B till assemblages accumulated between about 1.3 and 0.5*Ma.

The Loveland Loess (Daniels and Handy, 1959; Ruhe, 1969; Bettis, 1990) is the only Illinois or late middle Plesitocene deposit that is currently recognized in western Iowa. Where observed in outcrop, the Sangamon Geosol is developed in the upper part of the Loveland. The Loveland Loess thins away from the Missouri River and the Sangamon Geosol merges with the thick and more weathered Yarmouth-Sangamon Geosol in southern Iowa (Ruhe, 1967).

In Monona County, the highly eroded and dissected Pre-Illinois upland and older terraces are mantled by Wisconsin loesses of variable thickness (Ruhe, 1969; Prior, 1976). The Wisconsin loesses are the youngest regionally extensive Quaternary materials and were deposited between 30,000 and 12,000 years ago. Two loess units were deposited across Iowa during Wisconsin time, the older Pisgah Formation and the younger Peoria Formation. The Pisgah is thin and includes loess and related slope sediments that have been altered by colluvial hillslope processes, pedogenic and periglacial processes. The upper part of the unit is modified by development of the Farmdale Geosol. It is not uncommon to see the Farmdale developed throughout the Pisgah and incorporated into the underlying older Sangamon Geosol. The Pisgah Formation loess was deposited on the western Iowa landscape from about 55,000 to 26,000 years ago (Bettis et al., 2003) and is typically buried by Peoria Formation loess. The Peoria Formation loess accumulated on stable landsurfaces in western Iowa from 23,000 to 12,000 years ago.

Surficial deposits of the map area are composed of four formations: DeForest, Noah Creek, Peoria and undifferentiated Pre-Illinois tills. Hudson age deposits associated with fine-grained alluvial and colluvial sediments include the DeForest Formation which is subdivided into the Camp Creek, Roberts Creek Gunder and Corrington members. The Noah Creek Formation includes coarser grained deposits associated with large valleys which are overlain by finer-grained alluvial material or eolian silt and sand. Peoria Formation eolian materials consist of wind-blown silt that may be up to 46 m (150 ft) in thickness. Limited areas of eolian sand may be present adjacent to river valleys. Additional eolian materials may be intermittently present mantling Wisconsin Episode terraces. Pre-Illinois glacial deposits are exposed in the map area along drainages and where loess cover is thin. Based on existing well data, Pre-Illinois deposits may be as thick as 91 m (300 ft) in bedrock valleys.

Soils series units from the Soil Survey of Monona County, Iowa (White et al., 1959) were categorized into surficial geologic units based on soil data and available subsurface geologic data from the Iowa Geological and Water Survey's GEOSAM database (water well log database) as well as other existing subsurface data for this compilation map project. Modeling and mapping of the glacial till outcrops was completed using ArcGIS 10.0, gvSIG open source GIS program and the Sextante landscape classification subprogram.

* We disagree with the younger 0.2Ma age estimate for Pre-Illinois glaciations presented by Balco and Rovey (2010) and suggest 0.5Ma is more consistent with regional data and stratigraphic relationships.

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Map Location

1:100,000

0 1 2 4 6 8 Miles

0 1 2 4 6 8 Kilometers

Base map from iowa DOT Road Map Layers 2009. Shaded relief from Iowa Lidar Project 2007-2011.

Monona_SFGeology.mxd, version 9/23/13 (ArcGIS 10.1)
Map projection and coordinate system based on Universal Transverse Mercator (UTM) Zone 15, datum NAD83.

The map is based on interpretations of the best available information at the time of mapping. Map interpretations are not a substitute for detailed site specific studies.